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Development of 4/16-Channel Data Acquisition System Using Lab VIEW

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Abstract: ***The increased performance of personal computers and their reduced cost has made it possible for development of PC based signal processing systems. Combining virtual instrument technology to achieve the purpose of physiological measurement has several benefits. These systems are efficient and cost-effective for acquiring andanalyzingsignals for example Acoustic emission signal, bioelectrical signal. Utilizing virtual instrumentation to achieve physiological measurement will largely decrease the cost and increase the flexibility of the instruments. This work aims at designing a virtual instrument for acquiring and processing of signal.***

Keywords: Data acquisition system, LabVIEW

1. Introduction

PC based data acquisition and analysis is an efficient and cost effective method for signal acquisition and monitoring. Isolation of the subject from the electronic circuitry is very important. Also, since the signal (e.g. acoustic emission, bioelectrical signal) level is very low, amplification of signals is important. Hence, a PC based system consists of additional circuits for isolation and amplification of the signals. Combining virtual instrumentation technology for physiological measurements is an upcoming technology that is currently rising up at a faster rate. The cost can be drastically brought down and the flexibility can be increased by use of virtual instrumentation. National Instrument's LabVIEW is a platform and development environment for a visual programming. The purpose of such programming is automating the usage of processing and measuring equipment in any laboratory setup. A key benefit of LabVIEW over other development environments is the extensive support for accessing instrumentation hardware.

2. Data Acquisition System

Data acquisition is simply the process of measuring a real-world signal, such as a voltage, and bringing that information into the computer for processing, analysis, storage Data acquisition and conversion systems are used to acquire analog signals from one or more sources and convert these signals into digital form for analysis or transmission by devices such as digital computers, recorders, or communications networks. The analog signal inputs to data acquisition systems are most often generated from sensors and transducers which convert real-world parameters such as pressure, temperature, stress or strain, flow, etc., into equivalent electrical signals. The electrically equivalent signals are then converted by the data acquisition system and are then utilized by the end devices in digital form.

3. Construction

The main objective of the current work carried on is to develop a virtual instrument which can acquire signal, perform noise elimination and amplification. Acquiring signal using NI DAQ, designing the suitable low cost amplifier for amplification. The acquired signal was displayed using LabVIEW front panel. The front panel and block diagram have been designed. The basic block diagram of data acquisition system is shown is as shown.

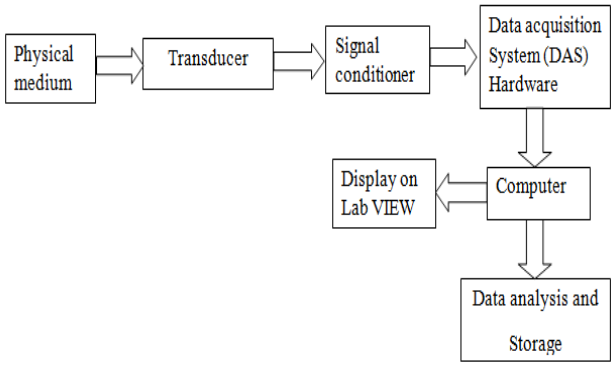

Figure 1: Block diagram of data acquisition system

1. *Physical medium:* Physical phenomenon like Temperature, voltage, pressure, force, light etc. are to be measured using data acquisition system.
2. *Transducer:* Providesactual interface between the real world and data acquisition system by converting physical phenomenon into electrical signals that signal conditioning and for data acquisition hardware can accept.
3. *Signal conditioning:* Electrical signals generated by transducers often need to be converted to a form acceptable to the data acquisition hardware particularly A/D converter which converts signal data to required digital format.
4. *Data acquisition system Hardware:* Data Acquisition uses three types of hardware: a terminal block, a cable, and a DAQ device.
5. *Computer:* All DAQ devices use the PC as a platform.
6. *LabVIEW software:* LabVIEW uses dataflow programming, where the flow of data determines execution order.

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7. *Data analysis and Storage:* data can be analyzed by using post processing methods like FFT processing, IIR processing etc. and saved in computer.

4. Design Consideration

A. Flow Chart of 4/16 Channel Data Acquisition System

Design of Block Diagram of 4/16 Channel Data Acquisition System

Block diagram is a wiring diagram of system. In designing, while loop is used along with case structure. Tab control is connected to selector label of case structure so that all the cases are execute. There are four cases namely start program, acquiring signal and processing, saving signal and stop created in case structure.

1. Start Program

The first case is designed to start program. Select not equal function from function palette and give two inputs. For first input, create enum constant and edit items, insert the tabs or tab names. For second input create property node and select tab control as a reference and value as property. Output of not equal function is connected to one input of OR function and another input is stop. For counting select numeric control and for timing control select time function and create constant with time 100 in millisecond.

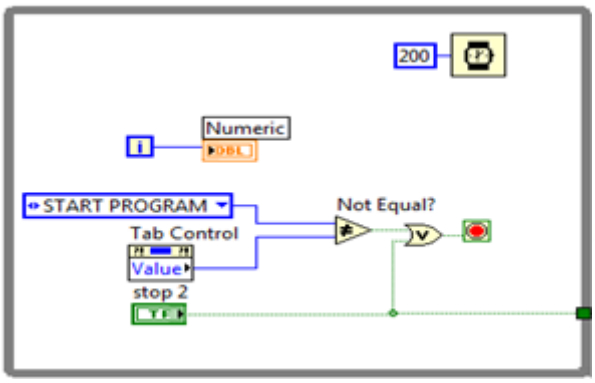

Figure 2: Start Program

2. Acquiring Signal And Processing

The second case is acquire signal and process it. Event structure is used to create three event case. In first event case, signal is acquired first and then displayed and give it to statistics block which returns input signal parameters. Basic function generator.vi and DAQmx read.vi are used to acquire signal. Function generator generates four types of signals namely sine, square, sawtooth and triangular. DAQmx read vi acquire signal from MAX which already created as a channels. Right click at the top of event structure and select edit event option and insert the items with value change application.

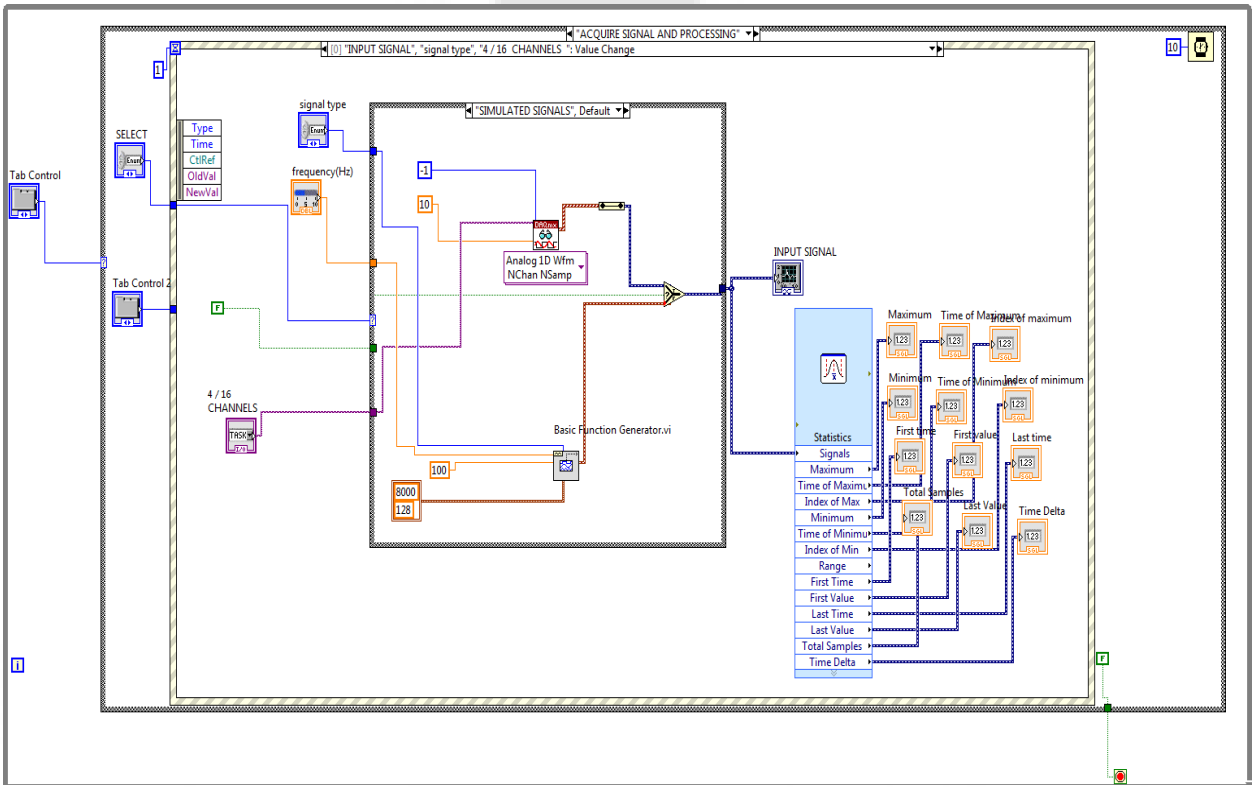

Figure 3: Acquire signal

In the second event case, input signal is first filtered using Digital IIR filter.vi and output of filter is fed to Power spectrum vi and spectral measurement express vi used to show FFT of signal.here also edit events of event structure and add events with value change application.

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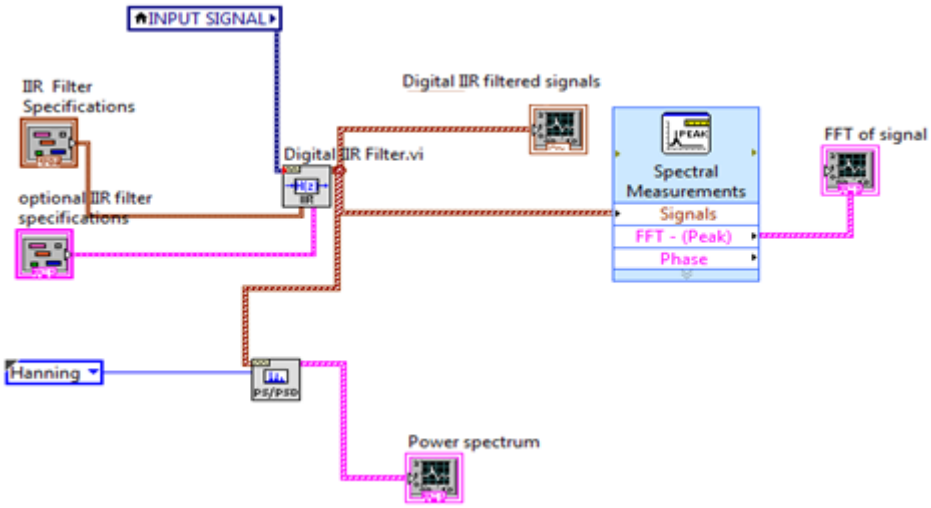

Figure 4: Post Processing

Third event case is timeout. Timeout Event Occurs when the Event structure times out. Wire a value to the Timeout terminal at the top left of the Event structure to specify the number of milliseconds. The Event structure should wait for an event to occur before generating a Timeout event.

3. Saving signal

Third case is saving signals. Event structure is used inside the case structure. There are five cases created in event structure which are saving all the results. First event case is designed for saving input signal. Create control of save button and name it input signal. Now create invoke node by right click on input signal indicator and select get image as value property. Give output of invoke node to write to png file.vi to save the image. The wiring diagram is as shown in figure 5.

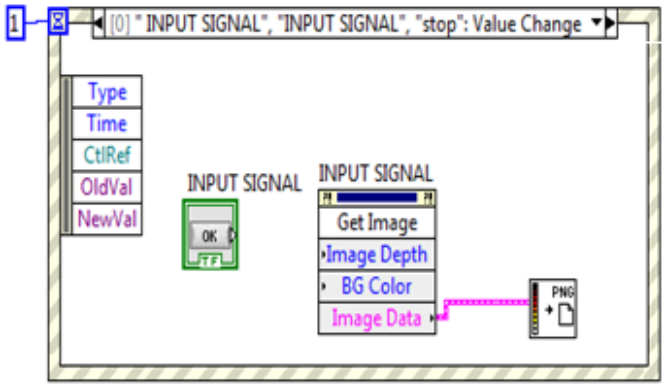

Figure 5: Save input signal

Second event case is used to save digital filtered signal. For that create save button control on block diagram and rename it as digital filtered signal. Create invoke node with value property and connect it to write to png.vi to save the digital IIR filtered signal.

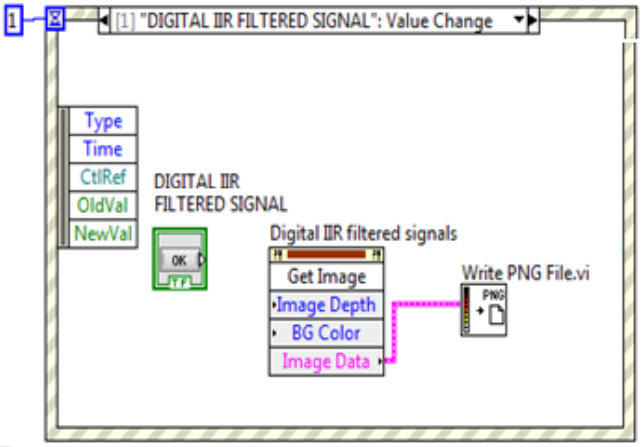

Figure 6: save digital IIR filtered signal

Third event case is used to save FFT of signal. For that create save button control on block diagram and rename it as FFT of signal. Create invoke node with value property and connect it to write to png.vi to save the FFT of signal.

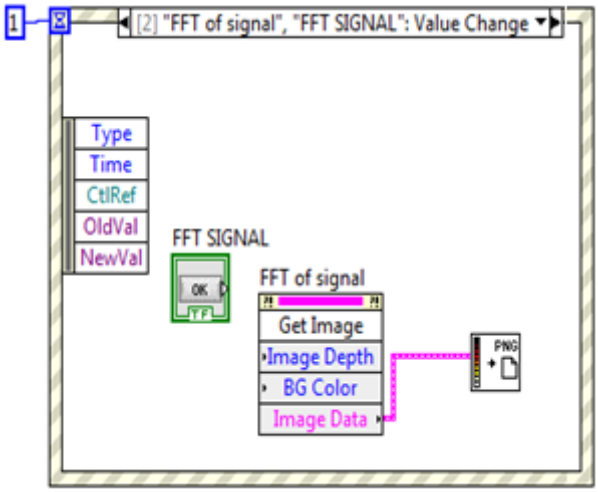

Figure 7: save FFT of signal

Fourth event case is used to save power spectrum of signal. For that create save button control on block diagram and rename it as power spectrum of signal. Create invoke node with value property and connect it to write to png.vi to save

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the power spectrum of signal. The wiring diagram is as shown in figure 8

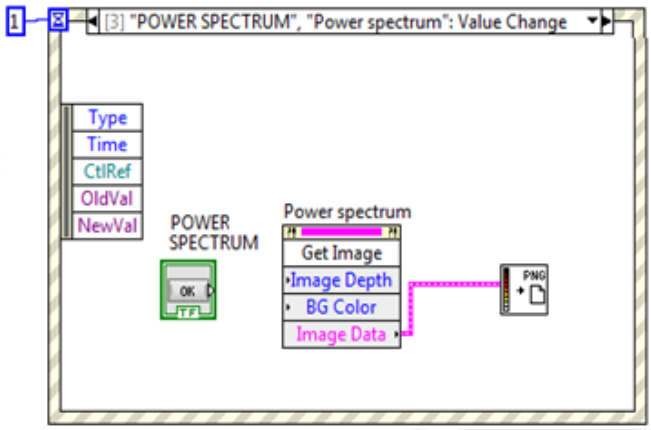

Figure 8: save power spectrum of signal

4. Stop

Stop control stops all programming because it is connected to conditional terminal of while loop. If condition is satisfy then while loop executes. At this case condition of while loop is satisfied thus program stops.

Design of front panel of 4/16 Channel Data Acquisition System

The front of 4/16 channel data acquisition is as shown below. There are four tabs created on front panel. When program start running, counting starts. It continued until user select new tab otherwise user can stop the program. The first tab of START PROGRAM is as shown in figure 9.

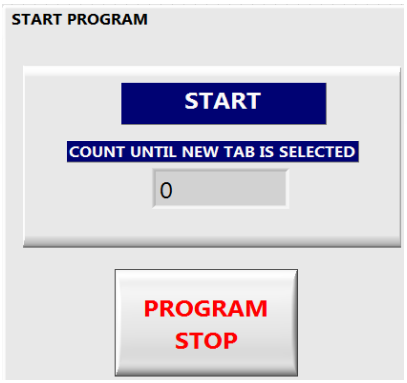

Figure 9: START program

Second tab on front panel is ACQUIRE SIGNAL AND PROCESSING. This tab has two sub-tabs.in first tab signal is acquired. Two types of signals namely 4/16 channel input and simulated signal that to be selected first and according to type of signal, select their parameters as shown in figure 10

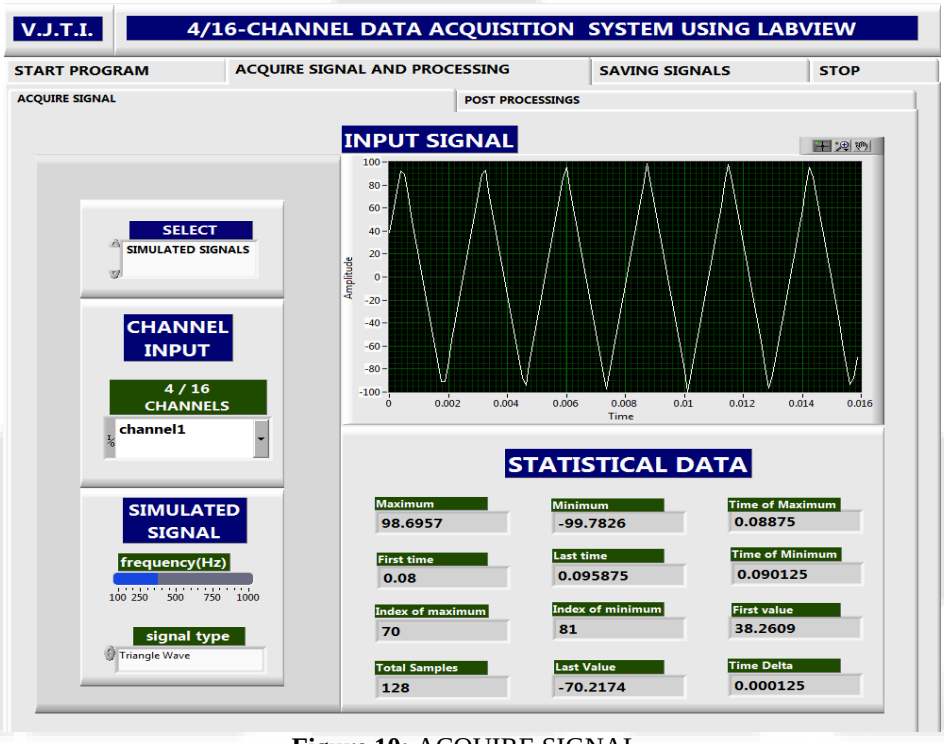

Figure 10: ACQUIRE SIGNAL

The second sub-tab of ACQUIRE SIGNAL AND PROCESSING is post processing. Here set the filter parameters, the digital IIR filtered signal, FFT of signal and power spectrum signal are displayed on graph indicator. The post processing tab is as shown in figure 11

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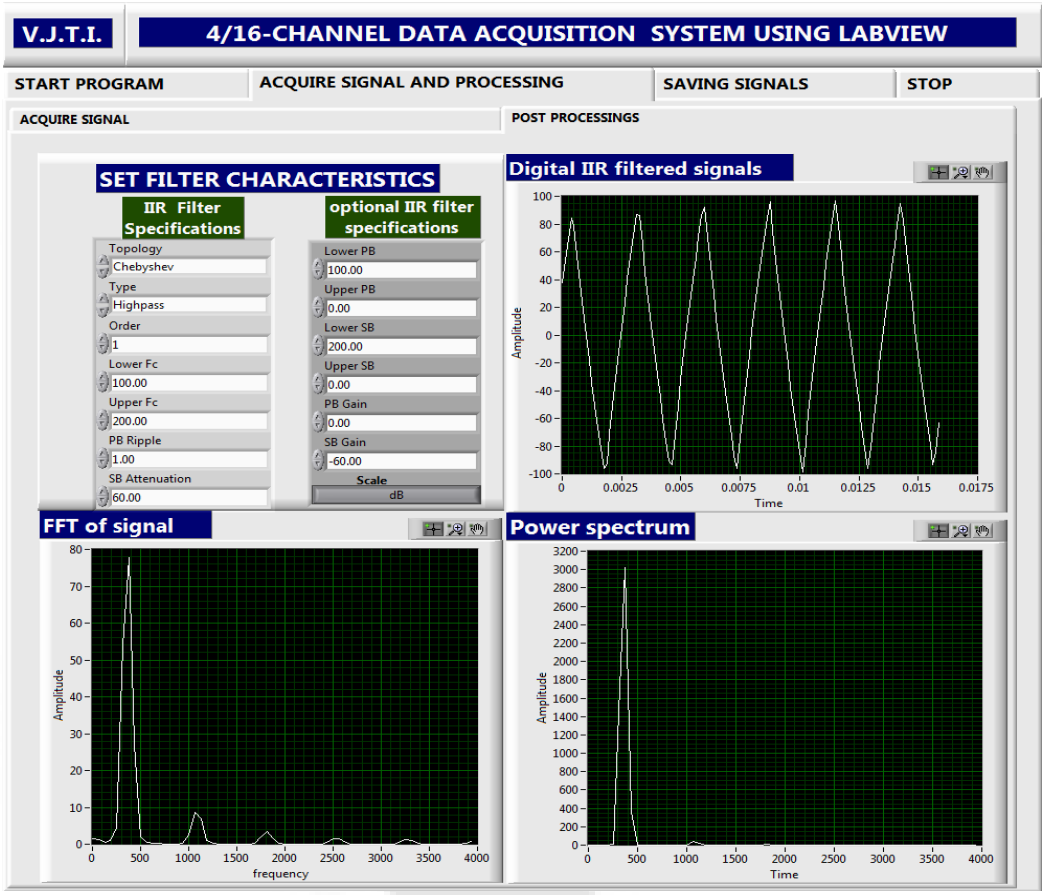


Figure 11: Post Processing

Third tab on front panel is saving signals. Press the save buttons of signals that to be saved. one window is appearing. Give destination path to save the image. The image is saved in .png format. The saving signal tab is as shown in figure 12

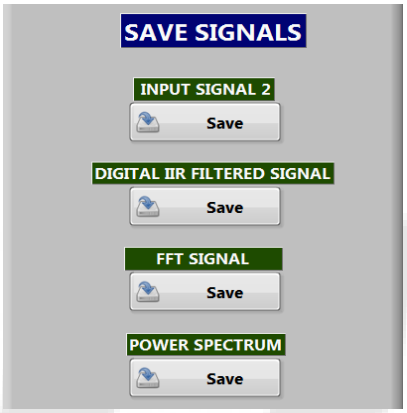


Figure 12: Saving Signal

Last tab on front panel is STOP. Here the condition of while loop is satisfied so program stops whole execution. The stop tab has stop button as follows is as shown in figure 13

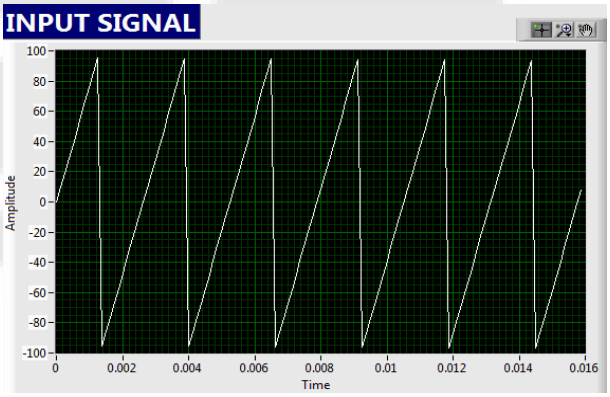
Figure 13: stop everything

5. Results and Discussion

The 4/16 channel data acquisition system using LabVIEW software is divided as first it acquire signals from user or system and then it filtered it and measure the frequency content of and convert the results to real-world units and displayed it using LabVIEW software.

1. Acquire Input signal

First signal is acquired by selecting channel input or function generator signal input which is also called simulated signal.



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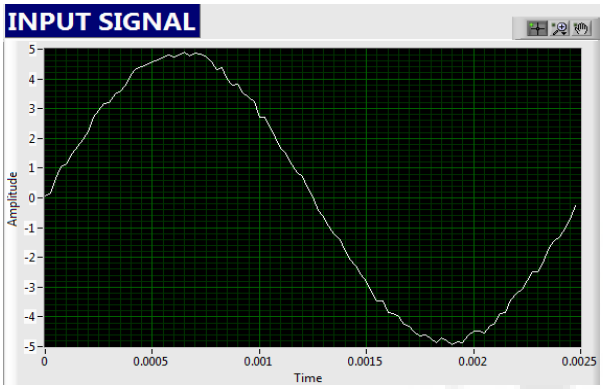

Figure 14: simulated signal and 4/16 channel input signal

Statistics block used in designing returns the selected parameter of the input voltage signal in a waveform as shown in figure 15.

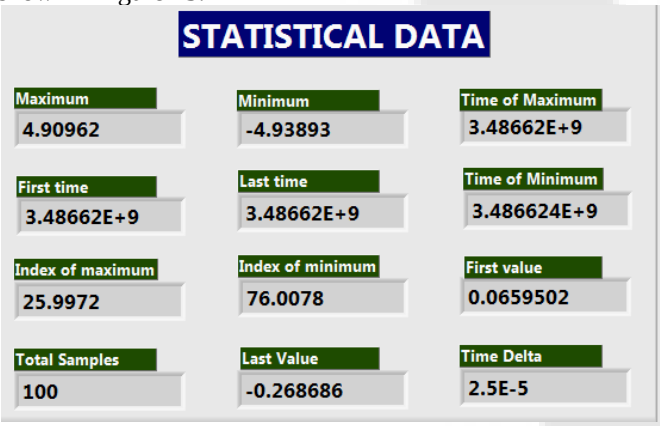

Figure 15: Statistical analyzed data

The parameters of input voltage signal which can be measured are as follows

Total samples: Returns the total no. of samples in signal.
Index of Max.: Returns the index value of the highest value of the highest pt. of the values in signal.
Index of Min.: Returns the index value of the lowest pt. of the values in signal.
Last value: Returns the last value in signal.
First value: Returns the first value in signal.
Time of Min.: Returns the time of the lowest pt. of values in signal.
Minimum: Returns the lowest pt. in a set of values in signal.
Time of Max.: Returns the time of the highest pt. of values in signal.
Maximum: Returns the highest pt. in a set of values in signal.
First time: Returns the first time value in signal.
Last time: Returns the last time value in signal

2. Filtering of signal

In this project filtering of signal is performed first by using digital IIR Filter. The function of a digital IIR filter is to remove unwanted parts of the signal, such as random noise, or to extract useful parts of the signal, such as the components lying within a certain frequency range. Due to filtering some amount of amplitude is decreases. The system can set filter parameters to get better filtering signal as shown in figure 16

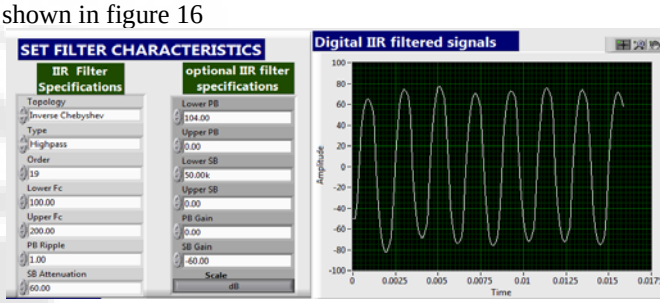

Figure 16: digital IIR filtered signal output

3. FFT and power spectrum of signal

LabVIEW comes with built in FFTs that make the process of component separation quick and easy. So spectral measurement block is used to show FFT based magnitude spectrum. FFTs produce the average frequency content of a signal over the entire time that the signal was acquired. Power spectrum which shows energy spreading into frequencies those were not present in original signal. The FFT and power spectrum is as shown in figure 17

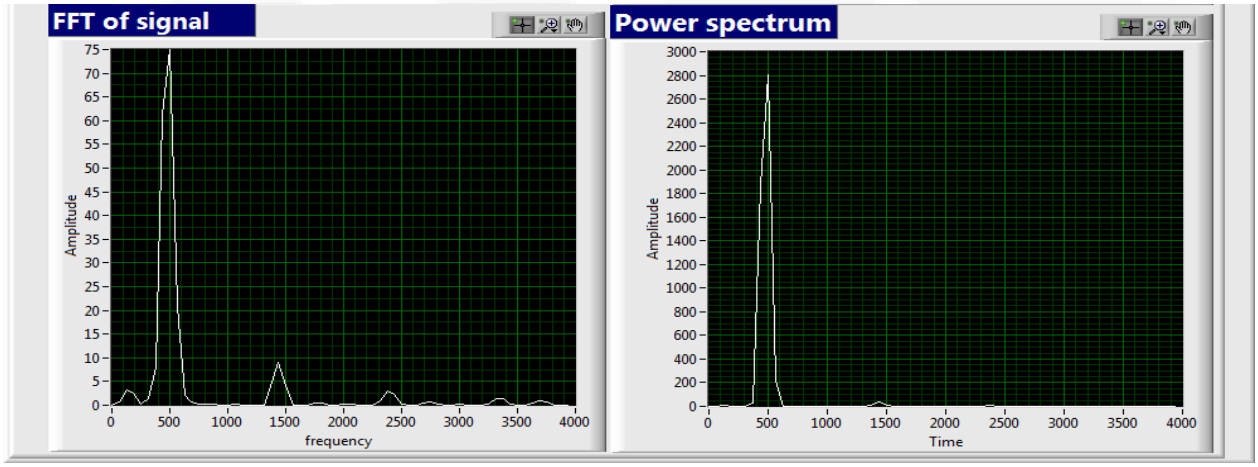

Figure 17: FFT and Power spectrum

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All the results are displayed on graphical user interface based program of 4/16 channel data acquisition system which work upon received data and process it effectively for optimum requirement of industry.

6. Conclusion and Future Scope

The 4/16 channel data acquisition System is basically enwrapped with PC based data acquisition. Here data is acquired in the form of electrical pulses of some micro volts range, filter them, amplify them and finally fed it to PC where a GUI based Program can work upon the received data and process it.

For developing 4/16 channel data acquisition system it is essential to meet the requirements are Configuration of the analog input, Actual reading of the analog input as per the parameters mentioned above, Displaying the waveforms/data acquired, Displaying the various data inferred from the acquired input, Post-acquisition analysis, Saving a data, Retrieving the data from a saved file for regeneration and analysis.

Here conclusion is that software developed acquires data from four and sixteen channel data acquisition system and requisite processing on the data can be done during functioning of software. Processing like pre-filtering using digital IIR filtering, FFT and Power spectrum etc. were visualized on front panel. As discussed in results FFTs produce the average frequency content of a signal over the entire time that the signal was acquired. The power spectrum shows power as the mean squared amplitude at each frequency line but includes no phase information. Because the power spectrum loses phase information, use the FFT to view both the frequency and the phase information of a signal. The power spectrum and FFT of signal are closely related to each other.FFT (amplitude spectrum) of signal is nothing but square root of power spectrum.

The data acquisition system developed has certain limitations in terms of accuracy and features like frequency and resolution. The system designed using LabVIEW has many advantages over system designed over MATLAB but it is the cost which has restricted LabVIEW to only large scale applications. Developed 4/16 channel data acquisition system is LabVIEW independent since it builds executable file in LabVIEW which can run in another computer without using LabVIEW software. Also this software can be employed for more no. of channels using recent and more advance DAQ devices. The four/sixteen channel data acquisition system is mainly designed to acquire acoustic emission signals. The acoustic emission system are capable of using multiple sensors/channels during testing, allowing them to record a hit from a single Acoustic emission event. This event can be detected on several channels. Through the analysis and processing of acquired AE signal, any defects inside the material can be detected.

References

[1] Hans-Petter Halvorsen, 'Data Acquisition in LabVIEW, Department of Electrical Engineering, Information Technology and Cybernetics, 2013.08.16
[2] Patterson Casmir D'Mello, Sandra D'Souza, Design and development of a Virtual Instrument for Bio-signal Acquisition and Processing using LabVIEW International Journal of Advanced Research in Electrical, Electronics and Instrumentation EngineeringVol. 1, Issue 1, July 2012
[3] HogskoienTelemark," *LabVIEW programming examples .pdf*", Telemark university Department of Electrical Engineering, Information Technology and Cybernetics.
[4] Jeffery Travis, Jim Kring "*LabVIEW for Everyone-Graphical Programming Made Easy and Fun*" 3rd Edition, prantice hall publication
[5] National Instruments,"NI-6115_6120 user manual", national instrument corporation, November 2002 edition.
[6] National instruments, "installation guide BNC 2110", National Instrument Corporation
[7] Michael Cerna and Audrey F. Harvey," The Fundamentals of FFT-Based Signal Analysis
[8] And Measurement" Application Note 041
[9] Dr. Peter Avitabile," Basics of Spectrum Analysis/Measurements and the FFT Analyzer", Mechanical Engineering - 22.403 ME Lab II, University of Massachusetts Lowell
[10] KishoriJadhav," comparative study of four channel data acquisition system using LabVIEW", international journal of engineering research and technology, volume 3,issue 5,may 2014
[11] https://decibel.ni.com/content/docs/DOC-3522
[12] http://www.ni.com/white-paper/3331/en/
[13] http://www.ni.com/LabVIEW 2012
[14] http://www.ni.com/NI-DAQmx 9.8

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